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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
KREINER, MICHAEL B	
ART UNIT	PAPER NUMBER
3644	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/595,621	DEFENDINI ET AL.	
	Examiner	Art Unit	
	Michael Kreiner	3644	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *20 October 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *14 June 2006* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "sensors disposed on board the satellite", "open loop servocontrol", and "Z-axis angular momentum profile" must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Objections

2. Claim 1 objected to because of the following informalities: "that are intended to" in the first line of the second to last paragraph appears to be an error. Appropriate correction is required.

3. Claim 1 is objected to because of the following informalities: "a third Z-axis actuator" should read "the Z-axis actuator" since there is only one such actuator and not three. Appropriate correction is required.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. The term "sufficiently small" in claim 1 is a relative term which renders the claim indefinite. The term "sufficiently small" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

6. A broad range or limitation together with a narrow range or limitation that falls within the broad range or limitation (in the same claim) is considered indefinite, since the resulting claim does not clearly set forth the metes and bounds of the patent protection desired. See MPEP § 2173.05(c). Note the explanation given by the Board of Patent Appeals and Interferences in *Ex parte Wu*, 10 USPQ2d 2031, 2033 (Bd. Pat. App. & Inter. 1989), as to where broad language is followed by "such as" and then narrow language. The Board stated that this can render a claim indefinite by raising a question or doubt as to whether the feature introduced by such language is (a) merely exemplary of the remainder of the claim, and therefore not required, or (b) a required

feature of the claims. Note also, for example, the decisions of *Ex parte Steigewald*, 131 USPQ 74 (Bd. App. 1961); *Ex parte Hall*, 83 USPQ 38 (Bd. App. 1948); and *Ex parte Hasche*, 86 USPQ 481 (Bd. App. 1949). In the present instance, claim 1 recites the broad recitation kinematic and dynamic variables, and the claim also recites attitude angles and angular velocities of the satellite along the X, Y and Z axes which is the narrower statement of the range/limitation.

7. Claims 1-10 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. It is unclear what the reference coordinate system in oriented to. Does the coordinate system rotate with the satellite, or is it absolute with respect to the Earth? It is unclear if the control moment gyros are supposed to comprise a third Z-axis actuator. It is unclear what is meant by "local position feedback control" since it is unclear what frame of reference "local" refers to.

8. It is unclear if the Applicant is claiming varying the orientation in claim 1, since the phrase "intended to" makes it unclear what steps are being positively claimed.

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

10. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heiberg (U.S. Pat. No. 6,241,194) in view of Bockman et al. (U.S. Pat. No. 6,360,996).

For claim 1, Heiberg teaches an attitude control system with no more than three primary actuators (CMGs 62 and 64 and reaction wheel 40). The CMGs comprise rotors connected to gimbals and oriented in the direction of the Z axis. The reaction wheel 40 delivers a torque vector in a direction not lying in the XY plane (fig. 2). The angular momentum vectors (74 and 76) move in the XY plane (figs. 2 and 3a-c) and define an angle between 0° and 180° (or, as defined by Heiberg, the angle is between -90° and 90°, col. 3 lines 39-43).

Heiberg's invention necessitates a control system to steer the satellite, however the reference fails to teach the kinematic and dynamic variables, which are necessary for controlling the attitude of the satellite, such as for example the attitude angles and angular velocities of the satellite along the three axes, are estimated from measurements provided by sensors used on board the satellite; setpoint variables, intended to allow objectives assigned to the satellite attitude control system to be achieved, such as for example the tilting and pointing along at least one of the three axes of the (X, Y, Z) coordinate system, are calculated; and control commands are calculated, from differences between said estimated variables and said setpoint variables, and then sent to the main actuators, these control commands being intended to control the change in said differences over time, said control commands transmitted to the control moment gyros comprising at least commands intended to vary the orientation of their gimbal axes, such as for example gimbal angular position setpoints that have to be generated by a local position feedback control, or electric current setpoints, for currents that have to be injected into motors for orienting the gimbal axes.

Bockman teaches estimating kinematic and dynamic variables using sensors on board the satellite (204 in fig. 5), calculating setpoint variables (202 in fig. 5), calculating control

commands from the estimated variables and setpoint variables (208 in fig. 5), and delivering the control commands to the rotors and the three primary actuators (210). (col. 7 line 64 to col. 8 line 38).

It would have been obvious to one skilled in the art at the time of the invention to control the satellite actuators with such a control system. The actuators need a control system to steer the satellite, and although such a system was not disclosed in Heiberg's reference, the control system disclosed by Bockman is a reasonable approximation of the very control system needed to steer Heiberg's satellite.

For claims 2 and 9, Heiberg teaches modifying the angle between the angular momentum vectors to a value less than 180 degrees using a secondary actuator (the rotor of CMGs 62 and 64) (col. 3 lines 39-51, figs. 3a-c).

Regarding claim 3, Heiberg teaches the control method as claimed in claim 2, characterized in that at least one of the following members is used as secondary actuator: magnetic-torquers, jet actuators, torque actuators of any other type, these preferably being selected from those of said aforementioned members necessarily used on board the satellite for carrying out operations other than the normal mode of operation of the satellite (38 in fig. 2, col. 3 lines 1-12).

Regarding claims 4 and 10, Heiberg teaches modifying the angle (α) between the angular momentum vectors (H1 and H2) (74 and 76 in figs. 2 and 3a-c) of the control moment gyros so that said angle (α) remains within a specified range (col. 3 lines 39-43). Official notice is taken that it is known to desaturate an actuator so that the output of the actuator is linear with respect to

the input. It would have been obvious to desaturate the reaction wheel so that the control system can predictably steer the satellite to the desired orientation.

For claim 5, Heiberg teaches that the angular momentum of the two CMGs is always oriented in a plane that is normal to the orbital plane (figs. 1 and 2). It would have been obvious for the angular momentum to pass through an orientation normal to the orbital plane of the satellite at some point during operation, for example during a station keeping procedure.

For claim 6, Heiberg teaches that the Z-axis actuator compensates for the total angular momentum of the CMGs (col. 3 *l.* 46-51).

For claim 7, Heiberg and Bockman teach establishing a setpoint configuration for the CMGs so that the angular momentum moves the CMGs and satellite to the setpoint configuration (Bockman 202 in fig. 5), generating a desired attitude maneuver with the Z-axis actuator (Bockman 212 in fig. 5), rotating the rotors using an open loop servocontrol (open loop shown in Heiberg fig. 2, with no feedback drawn to 78 and 80),and generating a Z-axis angular momentum profile by varying a speed of the reaction wheel (col. 3 *l.* 39-51).

For claim 8, Bockman teaches adding closed-loop commands to the open-loop servocontrol (Bockman 218 in fig. 5).

Response to Arguments

Applicant's arguments filed 10/20/2008 have been fully considered but they are not persuasive. Applicant has argued that Heiberg fails to teach a system that uses three primary actuators. Heiberg teaches a system with two CMGs and a primary reaction wheel, as well as other secondary reaction wheels. Applicants' arguments that the control system is more simple and accurate than that of Heiberg does not distinguish the Applicants' claims over the prior art of

Heiberg and Bockman. Heiberg does in fact teach limiting the angle between the angular momentum vectors to between 0 and 180 degrees, contrary to Applicants assertion (col. 3 *l.* 39-42).

Conclusion

11. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Rui et al. teach a method of steering a satellite using only a single reaction wheel and rotating appendage, such as a CMG (see attached document titled Three Dimensional Reorientation of a Spacecraft…).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael Kreiner whose telephone number is (571)270-5379. The examiner can normally be reached on Monday-Friday 9am-5:00pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Mansen can be reached on (571)272-6608. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Michael J. Carone/
Supervisory Patent Examiner, Art Unit 3641

/M. K./
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